

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization International Bureau



(43) International Publication Date  
4 August 2005 (04.08.2005)

PCT

(10) International Publication Number  
**WO 2005/071720 A1**

(51) International Patent Classification<sup>7</sup>: **H01L 21/205, 21/20, 33/00**

(74) Agents: **AOKI, Atsushi et al.; A. Aoki, Ishida & Associates, Toranomon 37 Mori Bldg., 5-1, Toranomon 3-chome, Minato-ku, Tokyo 1058423 (JP).**

(21) International Application Number:  
**PCT/JP2005/001294**

(22) International Filing Date: 25 January 2005 (25.01.2005)

(25) Filing Language: **English**

(26) Publication Language: **English**

(30) Priority Data:  
2004-017368 26 January 2004 (26.01.2004) JP  
60/541,071 3 February 2004 (03.02.2004) US

(71) Applicant (for all designated States except US): **SHOWA DENKO K.K. [JP/JP]; 13-9, Shibadaimon 1-chome, Minato-ku, Tokyo 1058518 (JP).**

(72) Inventor; and

(75) Inventor/Applicant (for US only): **URASHIMA, Yasuhito [JP/JP]; c/o Showa Denko K.K., 1-1, Ohnodai 1-chome, Midori-ku, Chiba-shi, Chiba 2670056 (JP).**

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

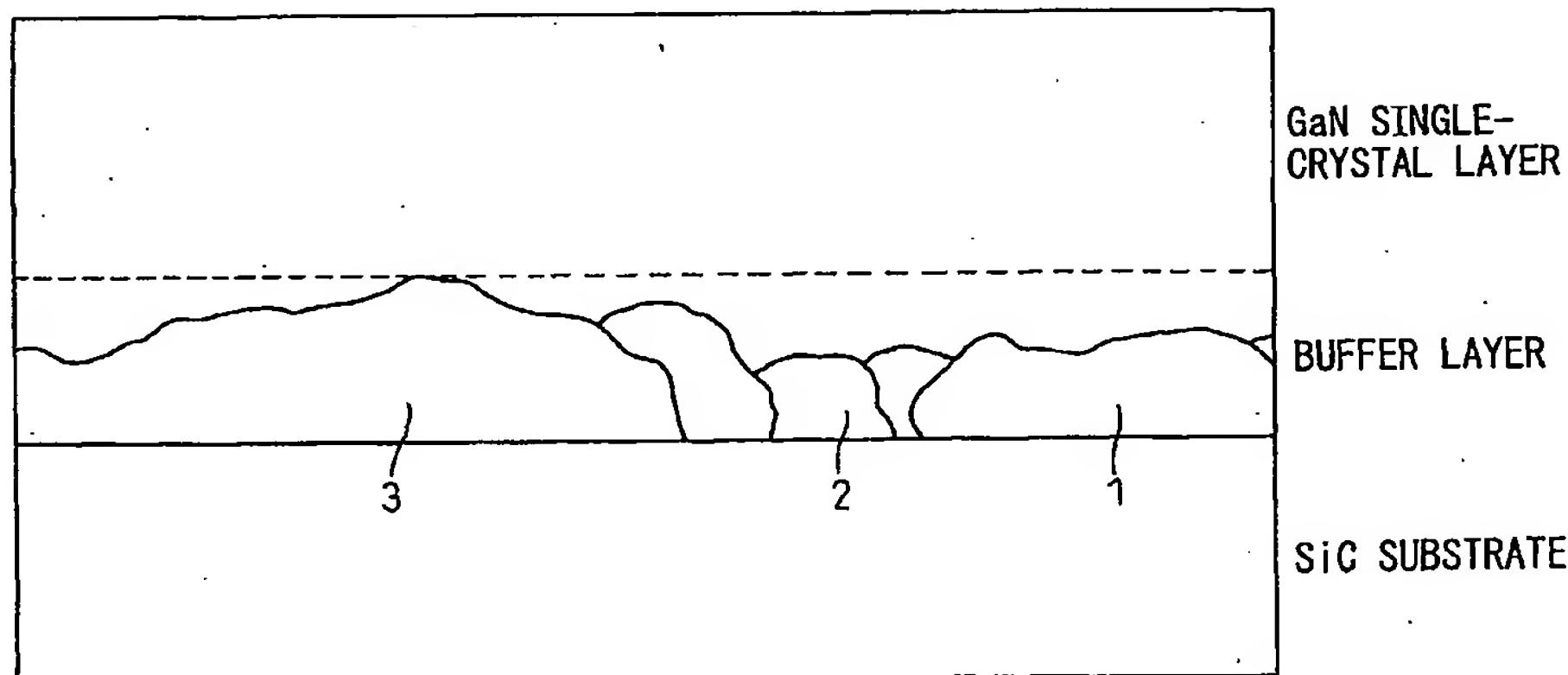
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

[Continued on next page]

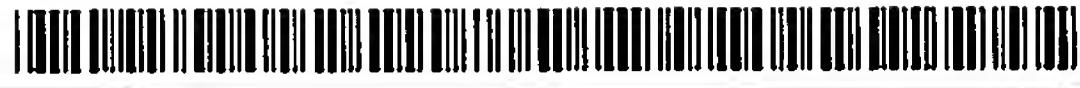
(54) Title: GROUP III NITRIDE SEMICONDUCTOR MULTILAYER STRUCTURE



WO 2005/071720 A1

(57) Abstract: An object of the present invention is to provide a Group III nitride semiconductor multilayer structure having a smooth surface and exhibiting excellent crystallinity, which multilayer structure employs a low-cost substrate that can be easily processed. Another object is to provide a Group III nitride semiconductor light-emitting device comprising the multilayer structure. The inventive Group III nitride semiconductor multilayer structure comprises a substrate; an  $Al_xGa_{1-x}N$  ( $0 \leq x \leq 1$ ) buffer layer which is provided on the substrate and has a columnar or island-like crystal structure; and an  $Al_xIn_yGa_{1-x-y}N$  ( $0 \leq x \leq 1, 0 \leq y \leq 1, 0 \leq x + y \leq 1$ ) single-crystal layer provided on the buffer layer, wherein the substrate has, on its surface, non-periodically distributed grooves having an average depth of 0.01 to 5  $\mu m$ .

WO 2005/071720 A1



*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*